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Florida State University Radio Observatory, Tallahassee, Florida

Personnel.

Dr. C. H. Barrow, Director and Assistant Professor of Physics; J. Buckley, L. Capone, D. P. Morrow, G. M. Resch, D. Thompson, Graduate Research Assistants; J. D. Merritt, Computer Programmer; Miss J. Van Pelt, Secretary; R. Whitworth, Electronics Technician; Kristi Armstrong, Denise Patronas, Pat Watson, Evelyn Thompson, W. Witgenstein, Undergraduate Assistants.

Outstations are directed by Ingr. H. Torgersen (Trondheim, Norway), F. W. Hyde (St. Osyth, England), Dr. L. Celda (Valencia, Spain), Dr. E. E. Baart (Grahamstown, South Africa) and Professor F. W. H. Wright (Kingston, Jamaica).

Research Program.

The decametric emission from Jupiter was monitored during the 1967-68 apparition. The emphasis this year was placed on several experiments concerned with the differences in burst structure and polarization observed simultaneously over small frequency intervals and from separated antennas on both long and short baselines.

The previous year's observations, notably the polarization studies by Barrow and Morrow, provided convincing evidence that selected events recorded under really good conditions providing top quality data, are in many ways more valuable than large statistics of the same quantities recorded under a wide variety of conditions. Consequently, some modifications were introduced into the established monitoring procedure and the Jupiter activity predictions computed by Merritt were utilized for a number of special observations. The observing program was divided into two parts as follows:

1. Routine nightly observations of left- and right-hand components at various frequencies to provide general data for future editions of the "Catalog of Radio Observations of Jupiter". General records were taken and monitored by a single observer.

2. Specialized observations by several observers on nights of strong predictions using high-speed and tape recording systems. These included polarimeter observations,

separated-site observations, millisecond pulse observations and close frequency observations. The quantities to be measured and the arrangement of frequencies were changed from time to time during the apparition so that a number of representative samples of high quality data were obtained which covered different aspects of the observations.

There are several reasons for these changes in procedure. One is that observations in the second category involve very large quantities of data which it is not always practicable to analyze without fully automated techniques. At present all data analysis involves a manual stage which is both time consuming and tedious. Also the Observatory does not have sufficient channels of high-speed recording and tape-recording to cover simultaneous observation of all the items of interest and it is debatable as to whether or not this procedure would even be desirable. The overall effect of the procedure changes was an improvement in the quality of the data with significant economy of both materials and time.

Some of the observations were restricted by the non-delivery of new two-channel custom-made receivers; this, unfortunately, prevented any significant advance being made in the study of millisecond pulses.

Barrow and Morrow have begun a study of the differences in polarization and burst structure over small frequency intervals. This is obviously an important consideration in the adjustment of equipment for location at out-stations in

spaced-site experiments.

Two polarimeters were operated simultaneously from the same antenna. The left- and right-hand component responses of these instruments were matched as closely as possible and the center frequencies were then varied by small known amounts. Io predicted events were used for the observations, and careful matching and adjustment preceded each observation. Allowing for the fact that the fine structure of the bursts is smoothed somewhat by the 0.1 sec time constant of the polarimeters, it appeared that both the burst shape and the polarization could be appreciably different for frequency separations as small as 50 kc/s.

Thompson has made considerable progress in the experiment to study the properties of the drifting diffraction pattern associated with the solar wind beyond the Earth's orbit. First observations from three sites on baselines of 10, 23 and 27 km are in various stages of analysis. Preliminary calculations made from the time delays evidenced by the cross-correlation functions of each of the pairs of sites indicates a drift velocity of the diffraction pattern of the order of 600 Km/sec, in the east-west direction. More detailed calculations will take into account the general case of anisotropic irregularities and thus allow the determination of the true velocity from the observed apparent velocity. The statistical properties of the diffraction pattern are also being investigated.

Statistical fitting programs are being prepared to fit theoretical spectral and amplitude distributions to the observational data.

Capone has continued his theoretical study of the upper atmosphere of Jupiter. Kuiper's model of cloud top conditions has been modified in the light of newer data and adopted as the basis of this study. Radiative equilibrium has been shown to be unstable in the lowest layers overlying the clouds, with the result that a shallow convective layer may be present. The calculated temperature profile differs somewhat from that given by Kuiper. Comparison of the effective cloud top temperature with that predicted from atmospheric greenhouse effects shows that the planet may contain an internal source of energy of the order of 0.6 that of the incoming solar flux. Strong radiative cooling by methane and its derivatives occurs in the mesopause which is found to be about 130 km above the cloud top. Absorption of solar ultraviolet and x-ray radiation has been shown to result in the formation of an ionosphere a few hundred kilometers above the clouds. Two model ionospheres, based upon hydrogen absorption and on hydrogen plus helium absorption in a model atmosphere, have been presented. The maximum equilibrium free electron density in both models is 5×10^5 cm^{-3}, resulting from atomic hydrogen absorption in the wavelength interval $804\text{Å} < \lambda \leq 912\text{Å}$. Although atomic hydrogen absorbs less than 25% of all photons of wavelength

less than 912Å, it contributes more than 90% of the total free electrons. A secondary peak due to helium absorption is possible if the atmosphere remains thoroughly mixed up to very high altitudes in the ionosphere. Molecular hydrogen is the dominant constituent absorber throughout most of the Jovian ionosphere.

I-pulse observations made during the 1966-67 apparition have been analyzed and confirm the effect observed by Baart, Barrow and Lee, that the main A source peak is not present in the System III longitude profile for this type of event.

Further data have been microfilmed for the NASA Space Science Data Center. Editing and copying for this purpose is now completely up to date.

Acknowledgments.

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Publications during the year included the following:

Barrow, C. H. and Morrow, D. P., "The Polarization of the Jupiter Radiation at 18 Mc/s", Astrophysical Journal, 152, 593 (1967).

Barrow, C. H., "A Radio Study of the Planet Jupiter", Ph.D. Thesis, London University (September, 1968).

Barrow, C. H. and Williams, J., "Continuum Emission from Jupiter at 18 Mc/s", Astronomical Journal, 72, 795 (1967).

Capone, L. "The Upper Atmosphere of Jupiter", M.S. Thesis, Florida State University (August, 1968).

Merritt, J. D., "Predictions of Jupiter's Decametric Activity", Florida State University Radio Observatory Report (July, 1968).

Torgersen, H., "Bursts and Pulses in the Jupiter Decameter Emission," Astronomical Journal, 72, 832 (1967).

Colin H. Barrow, Director